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Volumetric Reduction of Dyes With Hydrosulfite

By **W. C. HOLMES, C. G. MELIN and A. R. PETERSON**

Bureau of Chemistry and Soils, U. S. Dept. of Agriculture

This paper constitutes the 206th Contribution from the Color and Farm Waste Division, Bureau of Chemistry and Soils, U. S. Department of Agriculture, Washington, D. C.

A PRELIMINARY study was made of the possible utility of hydrosulfite in volumetric dye analysis by Siegmund in 1912. (W. Siegmund, Hydrosulfit in der Massanalyse, Monatshefte der Chemie 33, 1431, 1912). Several dyes of the nitro, azo and triphenylmethane groups, as well as indigotine, were titrated successfully with a tenth normal solution of sodium hydrosulfite, stabilized with acetone and ammonium hydroxide.

The method appeared of sufficient promise to warrant our further investigation. It provides conditions of reduction decidedly different from those provided by the use of titanous chloride (E. Knecht and E. Hibbert. "New Reduction Methods in Volumetric Analysis", 2nd ed. London, 1925) and might be found effective, we hoped, with certain dyes which cannot be evaluated advantageously by the latter method.

The equipment and technic employed were essentially identical with those of Siegmund. A minor modification which appears to have proved of value consisted in protecting the standard hydrosulfite solution from atmospheric oxidation by sealing the containing bottle in connection with a hydrogen generator, instead of relying upon a layer of paraffin oil for the purpose. Whereas Siegmund's solutions underwent progressive oxidation at a rate of about 2 per cent weekly, our solution remained unaltered over the month in which it was used.

The method was tested with twenty-five dyes of various types and groups, and fair results were obtained in thirteen instances. With the latter dyes the average of the results obtained with hydrosulfite was practically identical with that of those obtained with titanous chloride. The average variation in the dye contents of the individual dyes indicated by the two methods, however, was about 1.5 per cent. The best agreement between methods was noted with such readily reducible quinonimide derivatives as thionin, methylene blue, safranin and Nile Blue A.

Although there is no question but that it would be possible to employ the hydrosulfite method with many individual dyes it gives little promise, in our opinion, of any exceptional utility. Hydrosulfite appears to be less stable than titanous chloride under some conditions and circumstances of employment, and it is a decidedly less effective reductant with such dyes, in general, as are not very readily reduced. We have found no individual instance in which its employment appears advisable or advantageous.

New Ideas in Wool Scouring, Milling, Shrinking and Finishing*

By J. B. SPEAKMAN, D. Sc., F.I.C.

In this paper three processes—scouring, milling and shrinkage—are discussed in relation to the scale structure of the fiber. This structure presents a difficulty in the utilization of wool and is of the greatest importance. For some years a detailed study has been made of the milling process and the related scouring and chlorination of unshrinkable processes. New ideas in relation to these processes are herein presented.

AMONG the textile fibers, animal fibers, such as wool, are peculiar in possessing a surface scale structure. This outer layer or overlapping scales is far more resistant to chemical attacks than the interior of the fiber, for which it serves as a kind of protective armour. For wool to be processed without suffering undue damage, it is necessary that this scale layer shall be preserved intact. Interest in the scale layer is, however, not limited to its protective function; when fibers are twisted together to form yarn, they are necessarily brought into very intimate contact with one another. With wool fibers such contact is limited to point contact at the projecting edges of the scales, leaving between neighboring fibers a minute film of air which has the great merit of improving the warmth of a wool fabric. The superior warmth of wool fabrics is thus intimately related to the scale structure of the fibers.

The scale structure is also directly responsible for the milling process. Milling, too, is an essential preliminary to raising, and by means of these two processes it is possible, for a given weight of material to produce fabrics of great comparative thickness with wool, this being a second reason for the superior warmth of wool fabrics. Unfortunately, the increased thickness obtained by milling and raising is obtained only at the expense of a reduction in area of the fabric—*i.e.*, shrinkage. With untreated fibers this power of shrinkage is always present, and will always exert itself whenever a fabric is laundered. This is naturally a serious defect, particularly in hosiery goods, and the so-called "unshrinkable finish" has been devised to meet the difficulty. In this finish, having used the scales to produce the type of fabric desired, they are then rendered inoperative and the nature of the fabric made permanent. Unfortunately, in treating wool so as to make it unshrinkable in this way, the scales and the underlying cortex of the fibers are damaged to a greater or less extent, according to the severity of the process, and something of the protective action of the scales against damage by ordinary wear is lost.

This inherent difficulty in the utilization of wool is of the greatest importance, and for some years now a detailed study has been made of the milling process and the related scouring and chlorination of unshrinkable processes.

It is proposed to discuss the three processes—scouring, milling, chlorination—in relation to the main problem as stated.

The Scouring of Wool

The scouring of wool, whether as raw wool, yarn, or loom-state fabric, is usually carried out by means of solutions of soap, soda, or both. Such solutions are definitely alkaline, and alkalies have a harmful action on wool. The exact point at which a solution is dangerously alkaline has never been defined, and there has been a tendency to regard the alkalinity normally prevailing during scouring as being completely safe. Recent research carried out by Dr. Krais, of the German Textile Research Association in Dresden, has, however, shown conclusively that although certain alkaline solutions may cause damage to wool which is in itself barely measurable, this incipient damage is subsequently developed and accentuated during dyeing. To realize the best wearing properties of a fabric, it is imperative that the protective scale layer on the fibers shall be preserved intact; and it is, therefore, necessary to know the exact point at which incipient damage is caused by alkaline solutions.

Acids and alkalies have the power to open up the structure of the wool fiber and make it more easily accessible to reagents in general, thereby increasing the likelihood of chemical attack taking place. When the structure is thus loosened by either reagent, the fibers are much more readily stretched, and by measuring the extent to which stretching is facilitated in a number of acid and alkaline solutions, it is possible to define the exact point beyond which damage to a fiber may occur (Speakman and Hirst, "Nature," May, 1931). The results of such measurements are shown in Fig. 1, acidity and alkalinity being shown on a common scale of pH (pH 7 is neutral, above 7 to 14.5 is an increasing degree of alkalinity, below 7 down to 0.3 is increasing acidity). It will be seen that wool is completely immune to attack between pH 4 and pH 8. The significance of this result will be obvious

*University of Leeds, in a lecture, "Recent Development in the Study of Wool Finishing Processes," to the London Section of the Textile Institute.—*The Textile Manufacturer.*

when it is remembered that a 0.5 per cent solution of soda has a pH = 11, and a 0.05 per cent solution a pH = 10.6, both well outside the stability region. Similarly, a 0.25 per cent solution of a dry soap containing no free alkali has a pH of 10.16, while maximum scouring efficiency of soap solutions is realized only at pH = 10.7, values again well outside the stability region. It thus appears that we are again faced with a serious dilemma; wool can only be well scoured in soap and soda solutions which are sufficiently alkaline to be capable of attacking the fiber.

As far as raw wool scouring is concerned, the solution to the dilemma is to be found in the adoption of suint scouring. In this process the wool is cleansed by means of the suint (sweat) which it normally contains, and the pH of a suint scouring liquor is stated to be 7.2 to 7.8, within the stability region. For the scouring of yarn or woven fabrics the difficulty can be solved by the use of the modern synthetic soaps, such as Igepon A, which dissolves in water to give a solution of pH = 6.5. The use of suint and Igepon A has other important advantages. As will be indicated later in the paper, the felting of wool and the shrinkage of fabrics are at a minimum within the stability region defined above. Thus, in raw wool scouring the felting will be least and the production of noil least when suint scouring is employed. Further, by performing scouring within the stability region, the wool is obtained in an undamaged condition—*i.e.*, in the best possible condition for the subsequent carding, combing, and spinning operations.

It is thus clearly possible to preserve wool in the undamaged conditions up to the milling process, but milling requires strongly acid or strongly alkaline solutions. It may, therefore, be asked what necessity there is for elaborate precautions in wool scouring when the wool is to be exposed at a later stage of manufacture to far more drastic conditions. At least one important reason, as far as raw wool scouring is concerned, is that the wool behaves best in carding, combing, and spinning when it is undamaged.

Milling

The next process to be considered is that of milling. It is the most fundamental of all wool textile processes. As a result of a detailed study in the textile chemistry laboratories of Leeds University of the various aspects, it is now possible for the first time to give a complete explanation of every feature of milling shrinkage. The work has indicated a totally new possibility for making wool unshrinkable, dispensing with the chlorination process which is so likely to cause undue damage to wool.

The starting point for any argument on the milling process must always be the outstanding fact that the process is possible only with fibers which possess a surface scale structure. Cotton, silk, rayon, etc., are all incapable of showing milling shrinkage, and it seems certain that a scale structure is necessary for its occurrence. This view is substantiated by the fact that mohair, which has ill-defined scales, shrinks far less rapidly than, say, merino wool, which has well-defined scales projecting to a marked extent from the body of the fiber. It was originally thought that the felting and shrinking of wool fabrics in a milling machine are caused by the interlocking of the scales of adjacent fibers, but this view is discounted by the fact that intimate interlocking of this type has never been observed. The exact manner in which the scales promote milling shrinkage may be deduced from the experiments of Ditzel ("Deutsche Wollen Gewebe," 1891, No. 1). He showed that when fibers are subjected to longitudinal rubbing action they tend to travel in the direction in which the scales do not oppose motion—*i.e.*, in the direction of the root end. For example, when two locks of wool were placed end to end, with their root ends in contact, the action of the felting machine caused rapid interpenetration of the fibers from each lock, whereas when the tips were in contact no interpenetration could be observed. It seems clear from experiments such as these that the fibers composing a wool fabric will similarly tend to travel in the direction of their root ends under the action of the milling machine. The great penetrative power possessed by wool fibers is well illustrated by a discovery made by Dr. J. I. Hardy in the Leeds laboratories. After soaping a lock of wool, he enclosed it in a chamois-leather bag, and subjected the latter to the action of a milling machine. When the bag was subsequently opened and examined it was found that the fibers had penetrated the leather, the whole lock of wool being firmly attached to the bag. It remained for Shorter ("J.S.D.C.," 1923, 39, 270) to show that such unidirectional freedom of motion of fibers can cause the shrinkage of fabrics. His explanation is, briefly, that fibers travelling in the direction of the root end can carry along with them those fibers with which they are mechanically entangled. Under the action of the milling machine there will, therefore, be a continuous tightening-up of the structure, with decrease in its surface area and increase in thickness as a result. On the basis of this view of shrinkage it would be expected that the rate of shrinkage of a fabric in a milling machine would be determined by the magnitude of the difference between the frictional resistance to motion of a fiber in the direction of the root end, and that in the direction of the tip, the friction being greater in the latter instance. In the absence of complicating factors, this difference in friction and the rate of shrinkage should be directly related. Measurements of the scaliness of different wools were therefore undertaken (Speakman and Stott, "J. Tex. Inst., 1931, T339). The method consisted, briefly, in constructing a kind of violin bow from wool fibers arranged parallel to one another with their scales all pointing in one direction. The resistance of the bow to motion was measured in two directions—towards the root and towards the tip—the difference between the two values giving a measure of the scaliness of the wool and of the effectiveness of the scales in causing shrinkage in milling. In this way values for the scaliness of different wools were obtained ranging from 60.4 units for an

80's Australian merino wool to 5.0 units for mohair. These values are in good agreement with the recognized milling properties of the two types, and in the case of merino wools it was found that scaliness improves with wool quality, again in keeping with trade experience. Nevertheless, it must not be supposed that there is a perfect relationship between milling efficiency and scaliness for all kinds of wool. Indeed, in the case of Wensleydale, Oxford Down, and Southdown wools, the order of scaliness is exactly the inverse of the order of milling efficiency, as shown by the following data. The milling efficiency was determined by measuring the contraction in area of fabrics made from these wools when milled for a standard time in a milling machine.

Wool	Scaliness.	Shrinkage %
Wensleydale	16.3	33.7
Oxford Down	21.3	28.0
Southdown	28.3	16.3

Hence, although the scales of the wool fiber are directly responsible for the occurrence of milling shrinkage, the relative merits of different wools are not determined solely by different degrees of scaliness. Other factors must also contribute to the different milling properties of different wools, and these factors are those of fiber length and fiber-diameter (wool quality).

The influence of fiber-length on milling shrinkage was determined (Speakman and Johnson) by constructing similar fabrics from (*a*) an ordinary Wensleydale wool, and (*b*) from the same Wensleydale wool cut by hand to a much shorter length. In the latter case cloths were made from yarns having different degrees of twist. The cloths were all milled together with soap in the fulling stocks and the following shrinkages realized:—

Wool.	Yarn Twist (Turns per inch).	Yarn Strength. Oz.	Shrinkage in Area in 4 Hours %
Long	5.0	60.0	13.4
Short	4.1	28.9	17.7
Short	4.8	40.4	7.6
Short	7.3	58.0	5.3

From these results it is clear that for the same number of turns per inch and for the same strength of yarn, long wool mills better than short wool. The case of short wool with only 4.1 turns per inch is exceptional in character, because the yarn was so weak as to be almost incapable of being woven. It need hardly be said that the above rule of the longer the wool the greater the milling shrinkage is applicable to trade practice only within certain limits. When the fiber-length is too great, milling takes place extremely quickly, but the surface of the cloth is cockled and buckled in such a way as to make it useless in practice. The influence of fiber-length on the rate of milling is, however, probably responsible for the inversion of the order of milling efficiency in the case of Wensleydale, Oxford Down, and Southdown wools, Wensleydale being the longest wool and Southdown the shortest.

The influence of fiber-fineness on milling shrinkage can be deduced from first principles. Scaliness, the factor which determines shrinkage, is a surface property of the wool fiber, and fine wools, which have a large surface per unit weight, must therefore felt and shrink more rapidly than coarse wools having a smaller surface per unit weight if other factors are assumed equal. This deduction has been substantiated by experiments with blended wools, in which it was found that the addition

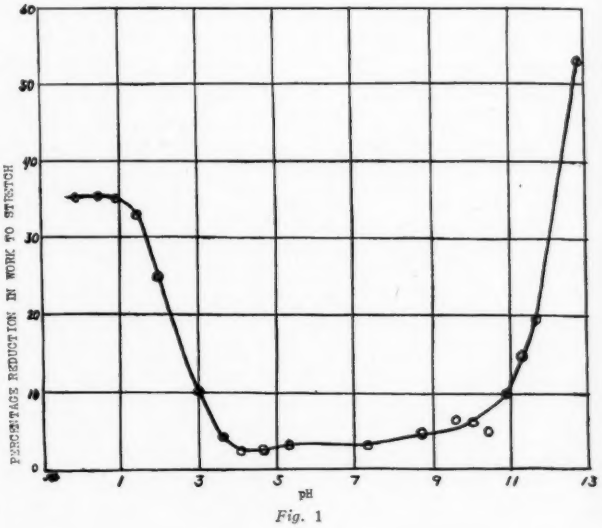

Fig. 1

of a small fraction by weight of a fine wool to a coarse wool produced a far greater change in milling properties than did a corresponding addition of coarse wool to a fine wool.

In this way those properties of the wool fiber itself which determine milling shrinkage have been accounted for in a fairly quantitative manner. The next step in the argument is concerned with the external conditions of milling. In the first place, milling can only be carried out in presence of an agent, such as water, which is assumed to perform the two functions of drawing fibers into intimate contact and reducing their flexural rigidity (Shorter). The promotion of intimate contact should facilitate milling by bringing the maximum number of scales on adjacent fibers into operation, while the reduction of flexural rigidity will similarly facilitate milling by allowing fibers to blend easily and negotiate obstacles during their travel through the cloth. It is, however, well known that the rate of shrinkage of a fabric is least when it is milled in presence of water alone, and increases with increasing acidity and alkalinity of the milling agent. Data for sulphuric and hydrochloric acids have already been published elsewhere ("J. T. I.," 1931, T339); but

(Continued on page 235)

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CALENDAR OF COMING EVENTS

Meeting Northern New England Section April 8.

* * *

Meeting New York Section, April 22.

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Council and Research Committee Meetings

April 1, 1932—Washington, D. C.

April 29, 1932—New York City.

June 3, 1932—Boston, Mass.

* * *

Meeting Southeastern Section, April 30.

* * *

Meeting Piedmont Section, April 23.

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SECOND MEETING, PHILADELPHIA SECTION

A MEETING of the Philadelphia Section was held at Greens Hotel in Philadelphia on Friday, February 12, 1932. This was the second meeting of the 1931-1932 season.

The business meeting was called to order by the Chairman at 8:15 o'clock P. M., following the usual informal dinner served at 7:15.

After the usual business the Chairman introduced Prof. C. C. Balderston of the Industrial Research Department of the Wharton School of Finance and Commerce, University of Pennsylvania, who delivered an address describing the results of an investigation of the upholstery industry of Philadelphia, which was conducted under his supervision.

Following this address Mr. Carleton S. Frances, Jr., a member of the section, exhibited moving pictures taken by him during an expedition to Venezuela. The pictures were described by Mr. Frances as they were exhibited. These pictures were exhibited at the last annual meeting in Boston.

After a rising vote of thanks to both gentlemen the meeting adjourned at 10:30 P.M.

Attendance at the dinner was 75 and at the meeting was 85.

Respectfully submitted,
Charles A. Seibert,
Chairman.

Proceedings of the American Association of Textile Chemists and Colorists

The Problem of A Declining Industry*

By PROF. C. C. BALDERSTON

Wharton School of Finance and Commerce, University of Pennsylvania

DECLINING industries are neither new nor uncommon. They are discovered almost as rapidly as vitamins—you know that in the best hotels nowadays, waiters are explaining a foreign object in the soup as a Vitamin B.

Our industries are constantly changing because of new products, new inventions, shifts in consumer demand and increased producing capacity. Much of this change is altogether desirable, but some of it leads to heavy social costs and to investment losses. You have only to examine towns from which its industries have departed, like the steel town of Coatesville, or the mining towns of Pennsylvania and West Virginia to appreciate what these social costs are.

This problem is by no means confined to steel and mining towns, for it is faced by the older industrial centers like Philadelphia and Boston when they are confronted by new and growing competition from lower-cost areas. In cotton, coal, shoes and in many other industries, the older areas have been forced to operate on a smaller scale. The loss of business seems usually to be felt first in the lower price, lower quality business. The workers suffer from more and more irregular employment; wage conflicts arise and, eventually, many of the workers from the older center have to sacrifice their trade skill and seek jobs in other companies.

To illustrate this story, we need only to point to the Philadelphia carpet industry, the Pennsylvania hosiery industry, the New England shoe industry and the New Jersey bottle industry. It is the story, likewise, of our northern cotton plants. The problem faced by all of these industries is to make the necessary adjustments to changes in the competitive situation with the minimum sacrifice of jobs, labor standards and investment.

Such a declining industry may choose among several possible courses of action:

—It may take no positive action at all, but merely drift, in which case, nature will take its course, and the industry in that region will either die, or become solely a high-quality, specialty business. This attitude reminds one of the Southerner with the ailing wife, who "hoped she would get well or sumthin'."

—Or, it may decide to meet the competition of the lower cost areas on a price basis alone. Such a policy is likely to lead only to lower and lower labor standards without permanently meeting the problem. It is obvious that communities with lower costs of living can, if necessary, reduce their labor costs further than the old, high-cost centers.

—Or, the declining industry may seek and perhaps find side lines which it can make advantageously. Such a policy may benefit an individual concern, but to the extent that it takes business away from other industries, it does not add to our national stability.

—Or, the industry may adopt measures which will make its retreat more orderly, if it accepts its ultimate decline and disappearance as inevitable.

—Or, the industry may attempt to hold the business which it could normally get in any event, and in addition, protect itself by meeting new competition from the outside. This method attempts to increase the stability in a given market by the intelligent use of price and wage differentials. The policy might be described as a combination of two types of business; "cream" and "skim milk". It may not enable the industry to completely regain what it has lost, but it provides at least a cushion. To the extent that it discourages new competition from the uninitiated, it adds to our national stability.

The Upholstery Investigation

The manufacturers and the unions in the Philadelphia upholstery industry asked the Industry Research Department of the Wharton School of the University of

*Paper presented at Second meeting, Philadelphia Section.

Pennsylvania to make a study of the situation confronting them. The Philadelphia industry comprises two dozen mills which make high grade furniture coverings and draperies. The typical mill is small (about 100 employees), and is therefore able to adjust its product rapidly to new styles. Most of these mills are old with established reputations. Of the seventeen which we studied in detail, five were founded prior to 1884, and thirteen prior to 1905. A decade ago, this industry enjoyed exceptional prosperity, with profits of about 20%.

In 1923, however, a downward trend began which, even before the current depression, had resulted in a serious shrinkage of sales, employment and profits. Four-fifths of the looms are now idle, a third of the workers have no jobs, and the remainder are on part time. If the general depression were the only cause, returning prosperity if and when it comes, would bring relief. But we feel sure that unless constructive measures are taken, the trends evident since 1923, will be aggravated by the slump.

The attractive profits of the industry a decade ago caused mills outside of Philadelphia to compete for the light drapery business and to take it away. This competition spread from the light-weight silk or rayon fabrics to the heavier cotton tapestries. In recent years, this competition has been augmented because Philadelphia mills have established branches outside. Moreover, the growth in imports has added to the trouble, for they grew from less than a $1,000,000 to nearly $5,500,000 in 1927.

To make matters worse for the Philadelphia mills, styles have changed during the last few years from the intricate and expensive fabrics to simple and inexpensive fabrics, in which an old center suffers the greatest disadvantage in cost. Yarn-dyed draperies have suffered also from the popularity of the cheaper cretonnes and blocked linens. Temporarily, at least, the buying public has been interested in cheapness and eye appeal.

All of these tendencies have resulted in over-capacity here and elsewhere, and in a buyers' market. The most serious production problem which it has caused has been a reduction in the size of customers' orders. This, in turn, has made for small and uneconomical manufacturing orders. On the selling side, the cut-throat competition has been evidenced in the piracy of designs, and in price cutting. The road which the industry has been following in the recent past stands out clearly from the facts, and unless remedies can be worked out cooperatively by unions and manufacturers, we will see a still further decline in Philadelphia. This road leads, therefore, to a most unsatisfactory future for those whose roots are in Philadelphia.

On the other hand, economic tendencies can be changed by concerted action. Our suggestion to those who have a stake in this business has been that they take steps to hold the business which would normally come here, and, in addition, work out such differentials as will make it possible to secure volume business on which the older center has not been able to compete. In order that labor standards may be maintained at as high a level as possible, it is suggested that all possible economies should be sought in manufacturing and selling. For example, it is proposed that on fabrics which permit it, the weavers should operate two looms instead of one.

The way out for a given industry must be adapted to its particular situation. But in spite of the Frenchman's comment that "all generalizations are usually false, including this one," we may say that a declining industry needs open-mindedness to new ideas on the part of both management and workers; flexibility in adjusting to new conditions and sufficent team-work to make decisive action possible. For the worker who gets pinched by the economic forces which play upon our declining industries, we need reserves to offer partial protection against old age and unemployment. As a preliminary step to all of these things, one who is interested in the study of business and its management must include sufficient investigation to reveal the facts as a basis for intelligent action.

Summary of the Findings

The Philadelphia upholstery industry comprises two dozen mills which produce high-grade furniture coverings and draperies. It is an industry characterized by rapid changes in style, and by emphasis upon individuality in designs. The typical mill is small, averaging about one hundred employees, and therefore is able to adjust its product rapidly to new styles.

Many of the mills have been established a long time and have built up valuable reputations for the quality of their goods. Of the seventeen which we have studied in detail, five were founded prior to 1884, and thirteen prior to 1905

What has happened to the industry?

Although it enjoyed exceptional prosperity a decade ago, with average profits of about 20 per cent, a downward trend started in 1923 which by 1928 had led to a serious shrinkage of sales, employment and profits. Of course, in 1930 and 1931 these conditions have been aggravated; in fact, each dollar's worth of fabrics sold in 1930 cost $1.12 to make and sell.

The existing slump, which has left nearly eight hundred of the 2,300 workers in the trade without jobs, and caused four-fifths of the looms to stand idle, is caused in part by the general depression. If this were the only

cause, returning prosperity, if and when it comes, would bring relief. But it appears certain that under existing conditions in the trade, a smaller share of the domestic orders will be made in Philadelphia than heretofore. One reason is that mills in sections like North Carolina enjoy an advantage in manufacturing costs of 16 to 24 per cent. To take advantage of this fact, one-third of the Philadelphia mills (the equipment of which equals two-thirds of that in the city) have established branch plants in other areas. These plans make and will probably continue to make goods which formerly were made in Philadelphia. This statement appears to be confirmed by the declining trend of the latter's industry since 1923. By 1930, the volume of sales was little more than one-half of the peaks reached in 1920, 1923 and 1925. The yearly earnings of employees have likewise fallen, the various occupations losing from 24 per cent to eleven per cent.†

Why has the Philadelphia trade declined?

At the end of the World War, the mills received a bonanza of orders at handsome prices from the advent of over-stuffed furniture. The capacity of the industry expanded rapidly, more jacquard looms being sold in 1919 and 1920 than in any other two-year period. The number of workers admitted to the Philadelphia unions more than doubled.

The attractive profits of the industry at that time also enticed mills outside of Philadelphia to compete for the business, especially on the light drapery fabrics which could be made in volume. This outside competition appears to have grown steadily until the depression and then to have increased still more rapidly. It spread from the light weight fabrics, made chiefly of silk or rayon, to the heavier cotton tapestries. The outside competition was augmented considerably by the migration of Philadelphia mills to lower cost areas. The addition of sizeable imports from Europe, which grew from less than a million dollars worth in 1921 to nearly five and a half million dollars worth in 1927, made the competition situation of the Philadelphia mills still more acute.

To make matters worse for the Philadelphia mills, styles have changed during the last few years from the intricate and expensive fabrics in which Philadelphia specializes to the simple and inexpensive fabrics in which Philadelphia suffers the greatest disadvantage in manufacturing cost. This trend is evident both in drapery and upholstery fabrics.

Yarn-dyed draperies have suffered also from the competition of the cheaper cretonnes and blocked-linens. The buying public has been interested, temporarily at least, in goods which were cheap and appealing to the eye. The demand for upholstery goods has witnessed a similar shift from the high to low-priced fabrics because as the general depression in business deepened, the makers of furniture have found that expensive furniture is not saleable during periods of business adversity.

Until 1931, this price cutting was more apparent in the cheapening of fabrics to undersell a competitor than in the actual lessening of prices on given patterns. Mills which copied designs also reduced the number of warp and filling threads in order to produce fabrics which looked somewhat similar but sold for something less. Consequently, the goods offered to the public have each year embodied less weaving skill and labor. In 1930, 135 per cent more material was used in relation to the weaving labor than in 1925. This process of cheapening has apparently been abetted by the demand of customers for appearance and low prices rather than for wearing qualities. Whatever the explanation, it has worked particular hardship upon the skilled employees in the Philadelphia trade who average twenty years of service, and who possess skill and experience acquired in making the more difficult fabrics of years ago.

The expansion to meet the demands of the peak years, combined with the changes in demand and the increasing competition from outside created a serious surplus of workers and mill capacity. Loom activity declined to such an extent that the weavers were paid for only one-half as much production in 1930 as in the years 1924 to 1926. Of the 2494 looms in place, about 40 per cent were in operation in 1929, and by 1931, the activity declined to 10 to 15 per cent. This over-capacity here and elsewhere has made the market distinctly a "buyers' market." It has catapulted the mills into severe and sometimes harmful competition with each other which is characterized by a wild scramble to secure volume and to reduce costs—a scramble which has brought with it "cut-throat" competition. This is especially evident in price cutting and in the "piracy" of designs.

The necessity for trying to maintain the volume of business has caused the mills to rely less and less upon jobbers as their principal sales outlet. Moreover, department stores which a decade ago had ordered draperies in large lots have placed their orders with mills outside of Philadelphia. To meet the situation, the majority of the mills then started to sell directly to large users of fabrics, like the furniture manufacturers, and three-quarters of the output of many mills is now disposed of in this way.

† In general, weekly earnings of employees have been decreasing since 1925. The average length of working week declined from over 44 hours in 1927 to about 31 hours in December, 1930. The annual earnings also declined, especially in 1930. In that year the average weaver earned less than $1,500, and the finishers, burlers and menders, and winders, less than $1,000. The employees in the last three operations are female. The loom-fixers, beamers and warpers and twisters earned between $2,000 and $2,500. Of course, annual earnings have declined still further in 1931.

This extreme urgency for securing volume has led to the most serious production problem in the industry, namely, small manufacturing orders. As competition has grown more acute, mills have displayed a willingness to sell in smaller and smaller quantities, until now the average order is for half a piece, which is from 25 to 30 yards in length. These small orders are often the original orders of the final consumer which have been relayed to the mills by jobbers or furniture manufacturers to avoid the keeping of stocks in a period of declining prices. In consequence, orders of the mills are now too small to be produced economically.

The reduction of selling prices in 1931 has forced attention to lower costs, but since one-half of the manufacturing cost is paid out for raw material, the possible changes to reduce costs are limited to those expenses which are controllable. The fact that a portion of the shop overhead consists of taxes, insurance, and depreciation on the buildings and machines means that these items cannot be reduced without endangering the permanence of the industry. Consequently, the managements look for possible economies in labor costs, selling and administrative expenses, as well as for the greater absorption of their fixed charges through additional volume.

To judge the possibility of securing volume adequate to permit the Philadelphia industry to continue on a sound basis as well as to provide more jobs for its workers, we must consider how much advantage in cost is enjoyed by mills in other areas. To answer it, however, we have been forced to rely upon information derived indirectly (i.e., which we could procure without having access to the records of all these outside mills). Even if the data of all competing mills were at our disposal, the great variations among them would make it difficult to generalize about the entire group of outside competitors. For example, the hourly wage rates in North Carolina are approximately one-half of those in this city. In other mills outside Philadelphia we find rates ranging from the low rates of the Southern mills to rates slightly under those in Philadelphia. The problem of determining the efficiency, or productivity per man-hour, is even more difficult because it varies for different groups of workers, differences in machinery, mill management, and type of fabric.

It is our belief that the greatest advantage over Philadelphia is enjoyed by mills in North Carolina which can make tapestries for approximately one-fifth less than can mills in Philadelphia. The advantage of these mills is chiefly in labor cost, and is created by lower hourly rates in all occupations, and by the fact that weavers operate more than one loom. The advantages gained by outside mills from lower taxes, power, and heat are negligible. In attempting to make a simple statement that the most advantageously situated outside mills have an advantage of perhaps $.20 out of each dollar of manufacturing cost in Philadelphia, we wish to emphasize that this is a crude estimate. The differences may, however, serve as an objective, or goal, at which the industry may aim in its efforts to effect the economies necessary to assure its stability.

What is the probable future of the Philadelphia trade if past trends continue?

The road which the industry has been following stands out clearly from the facts. Declining sales, production, employment and profits are clearly evident even prior to the depression. Under the present trade conditions, the manufacturing costs are perhaps 20 per cent lower in other areas, and the combined effect of the downward trend from outside competition, and of the current depression is a minimum of orders and employment as well as heavy losses for the mills.

Even if general business recovers, it is our judgment that the probable future of the Philadelphia industry, unless remedies can be worked out co-operatively by unions and mill owners, will see further decline in Philadelphia. The mills tending to remain in this area would be primarily small specialty mills. These mills could provide employment for a small part of the workers of the trade. Because of their long experience in this industry, the average length of service being twenty years, many of these workers would find it difficult to secure satisfactory jobs, or even a foothold, in other lines of work. In short, the investigation of the facts indicates that the road which the industry is now following leads to a most unsatisfactory future for those whose roots are in Philadelphia.

Analysis of the facts shows that the Philadelphia trade is moving in a direction contrary to the best interests of both workers and manufacturers. But in other similar situations, economic trends have been changed by concerted action. It is hoped that the suggestions presented may help the Philadelphia industry to adjust itself to new competitive conditions. The community, workers, and employers have interests at stake in the solution of its problems.

Proceedings of the American Association of Textile Chemists and Colorists

The Colorscope — Recent Developments*

By H. H. SHELDON and MILTON GLUCK

Sheldon Electric Corporation

PROFESSOR SHELDON: I know that you gentlemen know all about the color problem and what a difficult one it is. I know what finicky customers are and I know how difficult the situation becomes when a customer needs an excuse for refusing a shipment. Accordingly I am not going to go over all of the details of the color question before putting the machine in operation. However, I should like to point out our purpose in developing this machine. The purpose is to avoid the arguments which are bound to occur whenever the eye must be the final judge in color. As you know considerable differences in opinion may often arise between people whose intentions are the best. I think probably it is more difficult to judge color than to judge distance, and yet one would not be inclined to accept opinions on distances where accuracy is required. In the past, color measuring with accuracy has never been possible. We believe that we have made it possible now. At the outset, in building this machine, we realized that the people who needed it most were not desirous of learning to handle complicated equipment. We know that there are a great many practical dyers who do not desire to use intricate electrical apparatus, particularly when such apparatus takes a great deal of time. So our object at the outset was to make our machine simple. We have never put a dial on this machine if we could possibly avoid it. And the minute it was on we began to study how to get it off. We wanted to make our machine as simple and fool-proof as could be; we believe we have largely accomplished that purpose.

The easiest way to tell you about the difficulty of building this machine is first to tell you about the simplest machine that we made and then to build up from this. I like that method of experimentation. I was always a great admirer of Michelson who spent his entire life in measuring the speed of light. The first time he measured it over a distance of one meter. He gradually increased his distance to three miles and obtained a better result than he had ever achieved before. His ultimate accomplishment was that of measuring speed of light over a distance of forty miles. This gave him a final accurate result. I have tried to follow that plan.

The first machine we ever set up was extremely simple but impractical for a dye house. We simply took two photoelectric cells, joined them together in a combined circuit, amplified the result of the two and opposed them to each other. With samples before these cells, if the response of one were larger than the other, the galvanometer needle would go one way and if the response of the other cell were larger, the needle would go the other way. The reason we use two cells is very much the same reason that one uses two arms in a balance for weighing objects. If, for instance we had only a fixed weight on one scale pan we would not be able to get accuracy over any considerable variation in weights. If we decided on 100 lbs. on one side, we might successfully weigh 1,000 lbs. without any great amount of inaccuracy. However, we would have a large error if we weighed ten tons. Similarly, if our fixed weight was 100 lbs., we might be able to weigh an object of one pound, but it would be opening ourselves to great inaccuracy if we tried to measure objects weighing fractions of an ounce. Now, if you use only one photoelectric cell, and not two, and put in a resistance to obtain a balance, you are then using a method analogous to that which I have described in making the weighings. There is another reason for using the two cell method. If we have two cells we can then use two sources of light, both from the same feed line, and thus any variation due to change in voltage is automatically eliminated. For these reasons we use two cells instead of one.

Our first difficulty with this arrangement was an electrical one. We found a continuous drift in the galvanometer needle. It required a considerable amount of work to eliminate electrical leakage before this difficulty was overcome. Having done that, we were then able to take a real interest in what we were measuring. We put two pieces of cloth in front of the two cells, each about four inches square. We used this large size in order to reflect more light. We at once found we had trouble with weave and sheen. This made a complete study of the optical part of the machine necessary. We

*Presented at Feb. meeting, Northern New England Section.

were able to forget our circuit for the time being and entirely rebuild the optical parts so that the samples might rapidly rotate. This was done in order to produce an integrating effect by blending into a solid sensation the weave, grain and construction of the materials tested. When we next built a machine to successfully handle these small rotatable samples, we discovered that, with the small amount light reflected to the cells, our machine was not sensitive enough to read fine variations. So we went back to our circuit and started work all over again to develop it to a point that would give us good readings with the small size samples. In that way we built a machine somewhat similar to the one you see here.

At that point we began to give a little more thought to our photoelectric cells. Unfortunately, these cells responded differently to light from the way in which eye responds to light. We found that there were no cells suitable for matching colors the way the eye does because of their lack of sensitivity in the red region of the spectrum. Then a cell was developed which was even more sensitive in the red region than we wanted it to be. With this cell, other questions arose. Since heat from the lamps and other parts of the machine gave an immense amount of trouble, it was necessary now to re-arrange the entire apparatus so air currents could carry the heat of the lamps out of the machine. We also devised a filter system that would cut off the unnecessary red rays. This was successful but required a great amount of experimental work. Having done that we knew that our cell was still not like the human eye in color sensitivity so we had to work on further filters until we were able to put before these cells an arrangement that left a result similar to the sensitivity curve of the human eye.

Now, without all that work on filters (and that is probably the greatest secret of the machine) the electrical circuits could do nothing. When we put two pieces of cloth in the machine and the two pieces of cloth are exactly alike, we will obtain a zero reading. If the machine does not read zero, the two pieces differ. That assumption is correct if the two pieces of cloth are of the same cast. However, at the time, we found it quite possible to fool the machine. It had no brains then; but we have put some in it since. At that time if we put in a piece of red cloth and a piece of green cloth, each of which reflected the same amount of total light, that is, were equally bright, the machine would show them to be a match. That did not disturb us because we were already prepared to take care of this particular trouble. We took advantage of the work done many years ago on filters to devise a slide which will hold the three primary colors, orange-red, green and violet-blue. The eye sees color by means of these three primary sensations so that one way of describing color would be to say what intensity was transmitted through each of these three primary filters. If now we took the green and red sample we were talking about before and put this red filter in the machine, then the machine could no longer be fooled. The machine would show a considerable difference. In this way we were able to make determinations not only of the lightness and darkness of cloths, but of the difference in cast. The method we have is simply to take a reading with the red filter in place, then the green filter, and then the blue filter, which as you can see from my operation of this slide is a simple procedure.

Before going any further, I want to tell you about another of the difficulties we had to overcome, and this was far from simple. The eye is a complicated mechanism and when the eye looks for the least perceptible difference between two colors, then that least perceptible difference is always a percentage of the amount of light reflected from the colors. That point was first made clear many years ago by two physicists who discovered the principle independently of each other. One was Feschner and the other was Weber. Let me make myself somewhat clearer. When we look at a white object, a comparatively large amount of light is reflected to the eye; when we look at a black object, much less light is reflected to the eye. The least perceptible difference in total intensitivity is generally held to be about 2%. Now, if we look at two whites, the least perceptible difference is 2% of this fairly large amount of light reflected from the two samples. If we compare two blacks, the least perceptible difference is 2% of this comparatively small amount of light reflected to the eye. In other words, the least perceptible difference is not a constant amount of light but it is a certain percentage, and I emphasize *percentage*—it is a certain percentage of the light reflected to the eye. In its operation, the eye is an intricate mechanism of rods, cones and iris connected with our mental process. Of course, a photoelectric cell is nothing like this. In order to make the photoelectric cell function as the eye does with regard to least perceptible differences, it was necessary to incorporate in our optical system an iris diaphragm that would be open for blacks, closed for whites and set to suitable adjustments for in-between shades. The only question involved here was the setting of the iris diaphragm which might require judgment on the part of the operator. In order to eliminate judgment entirely, we established an auxiliary circuit which enables the machine to pick its own setting for the iris. By pressing this little button on this side, the machine automatically becomes dulled to such a degree that the entire range from darkest black to lightest white can now be measured on the galvanometer scale. When this button is down, I am enabled to see how light any sample is when compared with the standard black plate I have and this shows the correct setting for the iris. When the iris is thus set for any sample, the

machine then functions for that sample at standard sensitivity. At standard sensitivity we mean that five divisions on our scale are equal to 2%.

What I have said so far may seem intricate to you, and if that is so, it is because I have explained the details of "the works" and you have had thrust at you an analysis of the inside with which an operator normally may not wish to concern himself. In operation, of course, the operator measures his differences by inserting the two samples, pressing the button which rotates the samples and then interchanging them by turning this mechanical holder. This operation is then repeated after the red filter, the green filter and the blue filter has each been pulled out into place.

Suppose now, I have taken readings on these two samples of cloth I have and find that they do not match, on, let us say, the blue filter. What is the significance of that reading? If the machine shows that our sample is darker through any of the filters, the only way we can correct it is by subtracting color. This is often impossible in dyeing cloth. It is impossible, for instance, if you have just applied one dye to the cloth and found that that dye is too dark through one of our filters. It is pretty nearly impossible in some cases when it becomes necessary to strip the cloth. Now, on the other hand, if my unknown sample appears light through any of these three filters, I can correct it by adding dye, the color of which is complementary to the color of the filter. If the sample appears dark, it is necessary for me to subtract dye which is complementary to the color of the filter. We have said that this sample is lighter than this one from the blue filter. To correct it, we would add yellow dye.

Now, with regard to correcting colors, a number of questions arise; the amount of dye to be used and so on. Here a number of physical problems enter, many of which you are familiar with. Thus you know if we had a standard concentration of dye and added it to a piece of gray goods and we find that it darkens it, let us say 20%, then if we added to that another standard concentration, we find that it does not darken that cloth 40%, but somewhat less than this, following closely the logarithmic curve. This is another way of saying that the darker a cloth is, the less effect the standard concentration of dye will have on it. You know, of course, that if I took a gram of dye to a liter of water and treated a piece of white cloth with it, the effect will be much more marked than if I treated a piece of black cloth with it. In other words, the darker the material, the less effect the standard concentrations of dyes have. We say that this effect is exponential, but I shall not burden you except to say that it is possible to make a curve for dyes and determine how they will act.

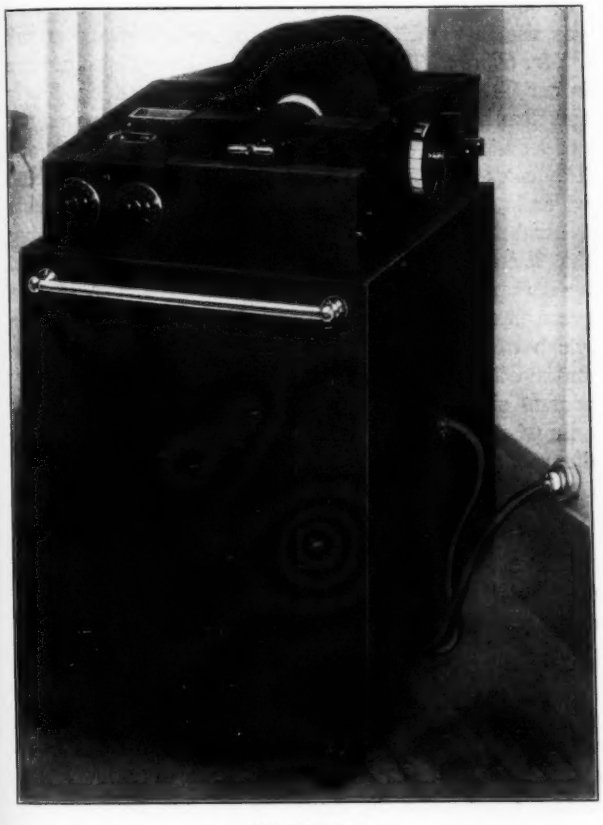
Now I think you will be more interested in seeing the machine operated than in hearing me talk about it. Our machine is now out of its infancy and considered a commercial product, and I will therefore call upon Mr. Gluck, one of the men who handles the commercial side, to show you the machine in operation.

Thank you.

Mr. Gluck: Perhaps the best way to demonstrate the Colorscope is to show you its operation in typical cases. Having thus seen the Colorscope in a general way, we can discuss questions that might arise or make any further tests that may be desired. After the current is turned on in the machine and the tubes have warmed up, and this takes about two minutes, the samples are placed in these holders. I put the standard sample on the right side and the unknown on the left. When I turn the switch, the samples revolve rapidly producing an integrating effect and blending the weave and structure into a solid impression. In that way I am enabled to compare tightly woven material with loosely woven material; or a paper with a grain with samples that are smooth surfaced. When the machine examines these colors in indirect light, sheen is not a factor, so that I am enabled to compare rayon with wool and so on, measuring only color. Now I bring the needle on the scale to zero by turning this dial and the black samples I have inserted have now been balanced, as we say. One of these samples as you noticed was black paper and the other was silk; one has a matte surface and the other has a shiny surface. When the needle is on zero, I turn this handle which interchanges the samples and enables the galvanometer to register the difference, if there is any. If the needle goes to the left, it means that our unknown sample is lighter, and if the needle goes to the right, it means that our unknown sample is darker, each 5 points being equal to 2%. You will observe that the needle goes off to the left passing the end of the scale showing that our unknown of the black paper is much lighter than the silk, it would not be considered a commercial match. These are somewhat difficult to see with the eye because the specular reflection of shiny silk often gives an erroneous impression. If you will examine these carefully, you will be able to see this difference. I know of course, that the light is poor in here and that you have not the benefit of north daylight. The advantage of the machine of course, is that it does not depend upon daylight or upon the human eye.

Now, keeping this same standard cloth, I will discard the sample of paper and take in its place another black silk sample. I keep the standard cloth on the right side and put the unknown piece I am testing on the left. The needle is now at zero; (the sample holder is turned so the samples are interchanged) the needle now goes ten points to the left. In other words, the machine says that our unknown sample is 4% lighter than our standard. If we were matching this in a plant where 4% was the

limit of tolerance, this would get by. Customers have often asked us what the limit of tolerance should be, and our answer is that we cannot set a standard for others to follow without being more arbitrary than we feel our position justifies. We know that in the silk business matches must be made with extreme accuracy. In other industries the limit of tolerance is sometimes much greater. Let us take chiffon hosiery for instance. If we were to hold up a thin stocking to the light and compare it with, let us say, some piece goods, it is so difficult to inspect color differences that we are inclined to overlook inaccuracies. Thus we feel that each industry will probably arrive at limits of tolerance for a commercial match by mutual agreement, and then individuals may even make exceptions to various customers for whom they may want more or less exacting work.



The Colorscope

There is a great advantage of having a limit of tolerance. The dyer who works without a machine often finds himself in this position. A sample is submitted by the customer; a test piece is dyed up and sent to him for approval; the sample goes out to St. Louis and we have to wait for the time required by the mails there and back again and any delay that is involved while the samples are in his desk awaiting inspection by the Vice-president or someone who may be required to pass on them. When we get our sample back again, how can we be sure that the entire lot of a few hundred pieces will be the same in color as the laboratory sample we have mailed the customer. The humidity may be different, the temperature different, a new barrel of red dye may be opened, our water supply may not be as clear, the day may be cloudy and the light poor, and worst of all, we may have a little touch of indigestion, so that staring at the two colors all afternoon, it may become very very tiresome and we may become very hard to satisfy; or worse still, our customer may get the indigestion, and then what? Now if we take business with this understanding, that matching must come within 5%, let us say, it is possible to make up a test piece and determine whether our sample comes within the limit of tolerance and whether we can go ahead and dye up the whole thing without waiting for an O.K. This means a saving very often, of time, needless worry and the possibility of a reject.

Here are some more samples of red wool. Let the machine see if they match, and if they do not match, what steps should we take to correct them? I place these samples in the machine; when I turn this handle the needle registers that my unknown is 6% lighter. Let me take a reading now on the red filter; the samples match. I now take a reading on the green filter; the needle goes light. I now take a reading on the blue filter and the needle shows almost a match. We will ignore this small difference. In other words, the machine said the three samples do not match because the unknown is lighter by 6% and that it reflects more green light. In other words, the machine says that if we add red dye to this unknown, we can correct our error and produce an acceptable match.

From this it is possible to see that we may put in samples of piece goods, determine the difference in the amount of the total light reflected on them, and in the event of a mis-match, see what steps should be made to correct same. Similarly, these principles may be applied to shading goods for uniformity in case packing, and measuring the tinctorial value of dyestuffs. For instance, if we are buying dye at $1.00 a pound and someone else offers it to us for 80 cents, and we know it is not quite as good, then are we getting more than 80% of the coloring value of the more expensive one; also is there any difference in the cast? We can use our machine tests to measure bleaching or for measuring the percentage variation produced after exposure of a certain number of hours to the Fadeometer—and these measurements are all made without employing the eye or daylight or allowing judgment or individual temperament to enter.

Thank you.

If there are any questions I shall be glad to try to answer them.

DISCUSSION

Mr. Grimes: It seems there should be some questions on this intensely interesting device. I had a dyer ask me if his job was still safe.

Mr. Gluck: I suppose you are joking, but of course, the Colorscope does not take the place of a man, but merely assists him.

Mr. Grady: I'd like to ask about the two black samples, one silk and the other paper, when you changed them you put in a piece of cloth, were they the same material? Isn't there a difference in sheen? How do you read brightness?

Mr. Gluck: When we speak of color we must be careful about the words that we use so that we do not become confused in our meanings. The word "brightness" is a little bit ambiguous. If it means that one surface is brighter than the other because it is shiny, then that is not registered at all by the machine because the rotation and indirect lighting enables us to avoid any of the mirror image effect that we may get from a shiny sample. Brightness is also sometimes used to mean lightness in the sense that white is lighter than black and brightness is also used to mean color purity. That might be a way in which the question of purity would come up. Suppose our customer submitted a yellow sample and we dyed our gray goods with a single yellow dye. When we compared this on the filters we found that the piece we had dyed appeared considerably darker on the red filter. This indicates that we must remove blue. Now, since we only added one yellow dye, it is physically impossible to remove the blue dye and so the machine is saying that the yellow dye that we have used can never match our customers' sample unless we take some blue out of it and that it is not bright enough or pure enough. Does that explain your question?

Mr. Proctor: If you were using a combination of colors, how about colors that match in some lights and do not match in other lights?

Mr. Gluck: Here is a very interesting consideration involved in samples matching in one light and not in others. Let us consider what causes this. Suppose I have a violet dye applied to a piece of cloth. Now, in daylight, I take some red and blue dye and mixed them together until it matches the first violet I had. To all intents and purposes they are satisfactory in daylight. Now the difference between Mazda light and daylight is that Mazda light has a greater intensity in the red part of the spectrum and less intensity in the blue part of the spectrum. If now, we bring our red and blue mixture into Mazda light, it will accentuate the red dye in our sample and enable the blue part to respond only feebly, so that our color will look altogether different from the sample that we started out with. Now, in order to consider these things with the Colorscope, we recommend that if there are any question of cast, one should always take a reading on the three filters. The eye observes color through these three primary sensations and if samples match in red light, blue light and green light, they will match in any combination of these such as white light. Now when we slide these filters into place, it is equivalent to examining our samples in red light, green light and blue light, and if samples match on these three filters, the samples will then match in any kind of light with which we come in contact ordinarily, such as daylight, Mazda light, arc light or any combination of these.

Mr. Grady: In the other part I thought perhaps there was a more minute determination, that is, by using the filtered screen. Is there a great difference in the blue you use in the filter and the blue used for correction?

Mr. Gluck: The three primary colors which we have in our filters are orange-red, green and violet-blue. Their complements are referred to as the primary colors of the artist and they are greenish blue, bluish red and yellow. The color that we use for correcting is greenish blue which is the primary color of the artist. We have made a number of readings on individual dyestuffs showing that if an operator finds that a sample must be corrected by darkening it, say 6% on the red filter, 4% on the green filter and 4% on the blue filter, he can determine which of his dyestuffs or which combination of dyestuffs will produce this effect. However, this is only general since it is necessary to take into consideration only what the cloth absorbs and not what is left in the dye vat. The machine cannot say in advance how much dye the dyer will leave in the dye vat.

Mr. Grady: What material are your filters made of?

Mr. Gluck: Some are made of glass and those are prepared by dissolving the coloring matter into molten material. Others are made by coloring a thin film of gelatin and then sealing this between two pieces of glass.

Mr. Grady: Suppose your filter is used and then another one is used in another determination, do you think the variation is enough to make a big difference in your calculation.

Mr. Gluck: In the operation of our machine, we always compare one sample with another, and in making a comparison in that way we avoid as much as possible of having any standards that may change as the current changes or as any other characteristics become altered. We make our filters with the greatest care possible. Glass filters for instance are ground on an optical machine to a hundredth of a millimeter. We found that for all purposes variations are so small as to be considered insignificant.

Mr. Grady: Why do you use a green filter instead of a yellow one?

Mr. Gluck: We follow the standard three color system which requires a red filter, a green filter and a blue filter. These are used to measure light with, that is, the light reflected from the cloth we look at. What we consider as color is sensation we get when light is reflected to our eyes from the various objects. We measure light with these three filters and they tell us which of the opposites or complements we should add or subtract to effect that light. The complements are greenish blue, bluish red and yellow. Those are the things the dyers and painters use. They may be considered as the bricks which make up a house. The filters in turn, may be considered as the instrument we use to see if the house is large or small enough.

Mr. Graham: These questions are all coming from one particular corner.

Mr. Derby: I have some samples here and they look fairly close in daylight, but in artificial light, they are very far apart. What will the machine show?

Mr. Gluck: Looking at them here in our orange shaded Mazda light, we can see that they are not a very good match; one appears reddish and the other a kind of khaki. It almost seems impossible to believe that these present a fair match in daylight and yet it happens quite often that samples will react in this way. Let us put this in the machine. We will call the khaki one the standard. Now we interchange these samples on the machine by turning this handle and the needle goes ten points to the left showing that they are about two shades apart and exhibiting not so bad a match in daylight. Let us see what happens with the filters now. I slide the red filter into place, now interchanging the samples. The needle goes so far to the left, that it is off the scale showing that these two samples could never be considered a commercial match. Seen in a red light (which may be considered an exaggerated Mazda light) these are unquestionably far apart.

Mr. Derby: How would you correct that color?

Mr. Gluck: We have found our unknown light on the red filter so we must add blue. On the green filter it has gone dark, so we must take out red. On the blue filter it has gone dark, so we must take out yellow.

Mr. Derby: How do you establish that in the curve of your illumination? In other words, how have you arranged to make the machine sensitive to color the way the eye is?

Mr. Gluck: We have inserted filters so as to give the required reaction at each part of the spectrum.

Mr. Derby: With what practical test can you determine that, without the theoretical work referred to, in order to show that the machine is sensitive the way the eye is?

Mr. Gluck: Our filters are checked with a spectroscope as closely as we can. If now we take a blue sample, a green sample and a red sample of equal brightness —and this can be checked with a little instrument called a flicker-photometer—and insert this in the machine, we get an equal reading on each of them. In other words, red, green and blue are equal intensity to the eye, react in similar intensity to the machine.

Dr. Smith: Is it necessary that a light in the machine resembles daylight. I am just interested in a practical test.

Mr. Gluck: The light in the machine does not resemble daylight when we look at it but it is of such a color that the photoelectric cells will react to it as we react to daylight.

Mr. Grimes: Here is another sample. What difference is there between these two?

Mr. Gluck: The machine now shows that one of these is darker than the other and on the filter tests I am now making you can see the reaction in order to determine the change necessary.

Other tests are made.

APPLICANTS FOR MEMBERSHIP

Student

Edgar R. Beigbeder, Lowell Textile Institute, Lowell, Mass. Sponsors: L. A. Olney and Charles L. Howarth.

John L. Birtwell, Lowell Textile Institute, Lowell, Mass. Sponsors: L. A. Olney and J. H. Skinkle.

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MARCH MEETING, NORTHERN NEW ENGLAND SECTION

THE Northern New England Section met in Riverbank Court Hotel, Cambridge, on Saturday evening, March 5. At the meeting 44 were present, and at dinner 39.

The program was arranged by William R. Moorhouse. Dexter Kneeland of the Bates Manufacturing Co., spoke on "Dyeing of Cotton in the Package Form on a Circulating Machine"; and F. L. LaQue of the International Nickel Co., on "The Use of Monel Metal Equipment for Dyeing with Developed Colors, Stripping and Bleaching."

At the next meeting in Shawsheen Village, on Friday, April 8, there will be a discussion on "Carbonizing".

Respectfully submitted,

H. C. CHAPIN,

Secretary.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

NORMAN ALBIN JOHNSON
Managing Editor

MYRON DREW REESER
Advertising Manager

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QUALITY OR PRICE COMPETITION

TO determine whether competition should be carried out on a price basis or a quality basis seems to be a problem facing every busniess enterprise today. In the textile industry competition has been to a large extent on a price basis. The result has been selling below cost, netting a profit of zero and leaving a deficit to be faced. This has been disastrous not only to the firms concerned but also in its effect on the purchasing public. It is threatening to destroy a market where quality and style value were pre-eminent, but which have been left to the mercy of a market placing undue emphasis on price. Consumers no longer seem to buy, they are being sold, whether they want to be or not. There is a demand for quality products but when they cannot be obtained the purchaser is forced to take something else, supposedly "just as good."

The fault for such a condition lies with the manufacturer, the retailer and the buyer. The manufacturer and the retailer apparently seem to think that goods should be sold wholly on a price basis and the consumer does not insist that they be sold on a quality basis.

In a recent statement Julius Forstmann, president of the Forstmann Woolen Company, said in part:

"The energy that was once directed toward the careful selection and assembling of a variety of stylish merchandise of good quality to meet the wants and desires of consumers of fashion merchandise is now largely diverted to price cutting and competitive selling with many manufacturers and retailers apparently determined to undersell the other, no matter what the eventual result to the producer or retailer or the ultimate consumer. Rigidly restricted 'hand to mouth' buying, excessive standardization of styles, overdone limitation of stocks to merchandise for which it is believed there is the most certain price volume demand, are all concomitants of a system which has adversely affected the public's understanding of what really constitutes style and quality merchandise. A study of the results of this destructive system reveals at once that it has benefitted no one. The public has gotten poor merchandise, and neither the manufacturer nor the retailer has made any profits in a producing and selling program based on foolish price cutting and uneconomic price cutting . . .

"The argument advanced in defense of inferior merchandise is that the present economic situation with its attendant reduction of individual incomes, makes its sale imperative. These arguments, to my mind, are basically wrong. It is not restricted incomes, nor has it been the demands of women as customers which have created this condition. It is true that incomes have been considerably reduced, but it is equally true that cost of good merchandise of every kind has fallen in equal ratio with incomes. The fundamental reason for the continued ascendancy of inferior merchandise is its determined and unceasing promotion *at low prices* by competitive manufacturing and retail outlets.

"This program with its resultant decline of quality standards and glorification of standardized price appeal gained constantly increasing momentum during the period from 1925 to 1929, admittedly the most prosperous years this country has ever seen. The result was that during these prosperous years when individual incomes were at their highest, the textile and a great many related fashion industries were not only operating with declining profits, but very often with increasing losses. It is a situation without parallel in any other period, or in any other country, and one which is definitely against public interest. It is destroying legitimate business, reducing employment and the incomes of those employed, and is lowering the standards of public taste in America. Until a remedy is found for existing conditions I see little or no chance for improvement in the textile situation, regardless of a future improved general business outlook."

The dyers are complaining that they cannot make a decent profit because the buyers are unwilling to pay for good work. They say that they find it necessary to use cheap dyes in order to meet competition. The reason for this is that they are competing on a price basis rather than a quality basis. The converters say that the demand is for a cheap product and that is what the retailers are forced to sell to the buying public. But is that what the public wants? On the contrary the public is not willing to sacrifice quality to ridiculously low price. No doubt they are getting what they pay for but not what they are willing to pay for.

If this foolish price competition would stop the public would be satisfied and the producers and retailers would stand to make a decent profit. The dyers complain that they are forced to cheapen their processes and they cry for help. Why not help themselves? If they would all refuse to do work which leaves them no profit it would

gradually lead to a betterment of conditions. This is practically impossible without an organized movement along these lines participated in by all the factors involved. Such a movement is now underway among the manufacturers of style merchandise. It is proposed to organize a group of such manufacturers to set fixed standards of quality. The method suggested is to forward a general educational campaign that will emphasize the economic and style value of merchandise of this character and also to coordinate the activities of existing organizations, and to encourage and foster the organization of such groups in related industries, as can assist in the proposed movement. The dyers are in no worse a position than other branches of the industry, and it is up to them to bring about their own salvation with the necessary cooperation of the other groups.

Communication re Mercerizing Machines

March 21st, 1932.

Editor, American Dyestuff Reporter
Dear Sir:

The article "Mercerizing in the Roll" in a recent issue of a contemporary textile publication is misleading and full of unwarranted and untrue statements, but as it is an anonymous communication I have no desire to challenge.

It was my privilege in 1908 to see the first mercerizing machine of the chainless system in operation at the plant of Heberlein & Co. in Switzerland. The idea to replace the tentering chain, holding the cloth at the two extremities of the selvage to pull it out to width with a system of expanding rollers, whereby every thread in the length and width of the fabrics bears the same stretch, appealed to me immediately, and from that time on over a stretch of 24 years I closely followed the development of piece mercerizing, and I believe to have in my possession more complete data and literature than anyone else on all the different types of machines, articles on the subject collected from over twenty textile publications and many books.

Between 1908 and 1914 various types and systems of chainless or box mercerizing machines (although the latter word is not the correct name) were placed on the market abroad, particularly by the leading machine builders in Germany, and I called on nearly all of them. Among the many systems, the machine built by the Zittau Works of Germany appealed to me most and I was on my way to the factory July 31st, 1914, to place an order for a first unit for one of my clients in this country, when the war broke out and interrupted my activities in that direction.

In 1920 the firm of Benninger in Switzerland brought out a mercerizing machine embodying a new principle of stretching contrivance, and I made the first installations in this country in 1924.

According to the list of references, Benninger has so far built over 50 complete mercerizing machines, installed in Switzerland, France, England, Germany, Poland, Czecho-Slovakia, Italy, Austria, Holland, Japan, etc.

Another list of references reveals that so far over 40 existing mercerizing tenters have been converted into the chainless system by replacing the tentering frame with the Benninger stretching apparatus. This stretching device, a curved shaft, a plurality of roll elements with anti-friction bearings, the elements rotating on a shaft, with conical sleeves, slidably arranged in the axial direction, but secured against rotation relatively to the shaft, is covered by U. S. A. Patent No. 1,668,994, issued May 8th, 1928.

A more recent U. S. patent, No. 1,814,652, issued July 14, 1931, covers a stretching device, whereby the curvature of the rollers decrease from the entrance end toward the delivery end of the device, each roller provided with slightly conical driving gear wheels. These rollers run in special ball-bearings easily and smoothly and are driven mechanically at about the same speed as the fabric; owing to their special formation they stretch the cloth in its entire width positively and uniformly without damaging the selvages or distorting the threads, as is the case with most other systems, and especially with chain mercerizers.

While many other mechanical refinements of the various organs of this most interesting machine have been made, the stretching apparatus can be considered as the soul and cardinal point of the machine.

It also stands to reason that Benninger, a firm of world-wide reputation, in business for 75 years, having built some 50 complete machines and altered another 40 mercerizers of seven other makes, must have gained unusually wide and valuable experience; and indeed, Benninger's latest type machine is truly a masterpiece that any American mercerizer can be proud to possess.

Real noteworthy developments and inventions encounter the greatest obstacles, prejudice and unbelief. The automobile, submarine, telephone, radio and flying machine are the best examples.

As to piece mercerizing equipment, my inquiry among the machine builders on the European continent reveals that in the past years an average of 9 out of 10 mercerizing machines built and delivered have been on the chainless principle.

Very truly yours,

A. W. BUHLMANN.

News Item

Clarence K. Simon, formerly president and general manager of Dye Products & Chemical Co., and lately connected with Calco Chemical Co., is now engaged in consulting chemical engineering practice.

Technical Notes from Foreign Sources

Dyeing of Worn Garments

Faerber-Ztg. 68, 20 (1932).—In the Question and Answer columns of the Zeitung, four replies are given to the query of a reader, which may be worth noting in some points.

a—Half-wool or all-wool garments should be dyed from an acid bath (formic or sulphuric); after dyeing, the acid is neutralized with a very little soda-ash or ammonia water in the rinsing bath, and the seam-threads (cotton) dyed in a short bath with direct cotton colors, with common or Glauber salt as assistant. A brown is best made up with the proper amounts of an orange, red, green, yellow, and possibly black dyestuffs; a green, by a yellow-blue mixture; an olive-green, by addition of an orange to the yellow-green mixture. The presence of soda must be carefully avoided, otherwise there is risk of spotty dyeings. Cotton garments, for a black, are dyed for one hour at 50°-60° C. in an old black-bath, and are then entered into a boiling-hot, very short bath, containing a cotton green, a cotton brown, and a cotton black, where they are dyed for an hour; steady boiling for ½ hour is advisable.

b—Half-wool goods are dyed with direct dyestuffs; brown dyeings require care, in order to get the worn areas evenly dyed. Brown may be darkened with black, green with a black-green, or with blue. Strong boiling is always to be avoided. All-wool goods are dyed from an acid bath, with an after-treatment at 50° C. for light-colored threads (seams).

c—Goods must first be well cleansed. Half-wool goods are dyed with direct dyestuffs, blended as desired, according to the color-cards. Woolen goods are dyed from an acid bath; cotton threads (seams) remaining light must be after-dyed with direct cotton dyestuff mixtures.

d—Much as above; particularly, the avoidance of soda-ash is emphasized, dry-cleansing being recommended. Worn garments should be dyed from an acid bath containing formic, not sulphuric, acid.

It is interesting to note that the four dyers furnishing the above suggestions agree upon the general procedure, that two forbid the use of soda, while two do not mention it, and that while one requires the use of an acid bath containing formic or sulphuric acid, two do not make any mention of a specific acid, while the fourth prescribes formic acid, and warns against the use of sulphuric acid.

Possibilities of Refractometry in Mixtures and Solutions

Dr. Otto Merz—Farben-Chemiker 259, 2 (1931).—The paper deals with the use of the refractometer in examination of liquids and solutions encountered particularly in the lacquer and paint industry, but the author's findings may be of some interest to those dealing with any modern solvents and media, in other directions. Several tables of the results of his study are given.

Fine-granular Forms of Animal Glue Recently Introduced

Dr. H. Stadlinger—Farben-Chemiker 266, 2 (1931).—The second part of a paper dealing descriptively with various forms of glue now on the market, in the form of pearls, tablets, etc.

Massive glue is a difficult substance to powder satisfactorily, on account of its peculiar combination of the properties of brittleness and elasticity; and such a powdered product is difficult to grade exactly into different degrees of size of particle, except by successive siftings, which, even though carried out automatically by specially designed machinery, do not make possible any desired maximum output of a particle-size specially desired. A later method, making possible the attainment of such an output of a product of specified particle-dimension, consists in coating the liquefied glue, in the gelatinous stage of cooling, upon flat tables, cutting up the gelatinous layer into tablets of desired size and shape by means of cutting-nets, the removal of the cut-up sticky and tender tablets from the cutting-table, and long and careful drying of them. The newest method avoids all this trouble by dispersing the liquefied glue, in a suitable medium, into droplets, separating these, and drying them, rapidly at first, at least, in order to get them coated over as soon as possible, with a film of dry glue, in order to prevent their sticking together during the drying process as a whole. This method, as compared to the older one, is so rapid, that the possibility of bacterial damage is excluded; the product is glue of the same grade and quality as the material used for the physical transformation; which is decidedly not the case with the tablet-glue produced by the older method. The pearl-glue swells rapidly (in 1½ hour), and so can be made up when needed; the older forms require perhaps 24 hours, the difference in time meaning that with this newest form there is no tedious delay, waiting for the swelling, and no danger of loss of glue-substance through leaching out during the long soak, as the preparation can be made up so soon before needed.

A form similar to the true pearl-glue is one being put on the market by a Swedish firm; the process consists in dropping the liquefied glue in a suitable manner into

finely powdered glue, which coats over the droplets with dry glue, and so prevents caking together during drying. Several other forms of glue, of definitely fine particle-size, are also described and illustrated.

Analysis of Hide- and Bone-glue

Dr. Ernst Goebel—Farben-Chemiker 366, 2 (1931).—A quantitative paper (part 2), dealing mostly with the determination of ash, qualitative and quantitative. Definite methods are given.

In a table added, of four specimen analyses of ash, two from hide-glue and two from bone-glue, the percentage of P_2O_5 shows plainly the source of the glue (traces from hide-, and as much as 0.0784% from bone-glue), but it is surprising that the figures for calcium (as oxide) are higher (1.110% and 1.330%) for hide- than for bone-glue (0.217% and 0.038%). The presence of determinable amounts of phosphoric acid in hide-glue is doubtless due, when it occurs, to the use of phosphates in clearing the glue, during its manufacture. Again, the presence of chromium compounds in a glue is to be ascribed to the use of tanned leather scraps in the manufacture of the glue. Occasionally, specimens of Russian glue, possessing a milky appearance, may contain as much as 20% of ash, due to the presence of much barium sulphate, which has been added for special purposes.

Waterproofing Processes for Garment Goods

Dr. P. Krais and Dr. R. Buchheim—Monats. f. Textil-Ind. 249, 46 (1931.—The authors have taken advantage of a request, on the part of a firm manufacturing a waterproofing medium, that they study this material in comparison with others, to look into the whole question of waterproofing in a broad way. The study involved twenty methods with different agents, applied to these types of fabric: one, a closely woven marine blue cotton cloth, another a black wool poplin, and the third a black crepe de Chine, whose warp was of acetate silk, and whose woof consisted of viscose silk. These dark fabrics were chosen with the idea that any separation of material from the waterproofing bath (of a lighter color, of course) could be easily detected. The samples were strips 25 cm. wide, sewed together by the ends; the baths were contained in flat, oblong, enamelled pans, and the goods were run over a reel of glass rod, kept in slow motion (75 cm. per minute) by electrical power.

Of the 20 procedures tested, the first four were two-bath methods involving aluminium formate/Marseilles soap, aluminium formate/sodium oleate, aluminium formate/sodium stearate, and Marseilles soap/aluminium formate; nos. 5-9 are described only as two-bath procedures, nos. 10-16 as one-bath procedures, and nos. 17-20 were trials of the products of the firm above mentioned (R. Bernheim, Augsberg-Pfersee), employing Impregnol SE (one-bath), Impregnol M, 50 g./liter (one-bath), Impregnol SE (two-bath), and Impregnol M, 20 g./liter (one-bath). The 19th trial, with Impregnol SE, was varied from the course recommended by the manufacturers, by treating the goods first with aluminium formate. In the first three, the aluminium formate, as a 6° B. solution, was applied at ordinary temperature, treatment for one hour; the goods then squeezed and air-dried. They were then treated in a soap-bath of 2.5 g./liter at a temperature of 30°-40° C., finally squeezed, and air-dried. The reverse order carried out in no. 4 was much the same in detail. The samples were finally ironed, which caused the spots (not many formed) to disappear.

For testing of the degree of waterproofing, three out of the various methods which have been proposed were used; the drop method, the funnel method, and the water-pressure method.

Tests with the drop-method—observation of the manner in which a drop of water placed upon the surface of the treated goods runs off, whether smoothly or with partial adherence—gave a good idea of the effectiveness of the method in general, and of the degree of "drop-fastness."

The funnel-method consisted in cutting squares of the prepared material, 25 x 25 cm., folding after the manner of a filterpaper, placing in a funnel of 14.5 cm. diameter, the cone of material filled with water, and the funnel subjected to gentle but steady and rapid vibration by means of a small electric hammer. After a given time the amount of water which had run through was measured, its rate of flow calculated, and the amount of water retained by the sample determined. The layer of water in the funnel was 10 cm. deep.

The third method, the water-pressure method, was carried out with the use of the cell from a Schopper pressure-tester, of 10 sq. cm. area, the attached water-reservoir being raised by clockwork 10 cm. per minute. Of course, with the untreated materials the water penetrated immediately. With the treated goods, 5 tests were made on each sample (fresh material in each case); the results were closely concordant.

The results cannot be given in exact figures, nor, indeed, are they so given except in a table of the results of the water-pressure method of testing; but the authors summarize the results briefly. Of the four methods of impregnation determined as best, three are based upon the use of the proprietary products mentioned, and the modification of the method prescribed by the manufacturers is not among these four.

Azo Dyestuffs Containing Chromium

German Patent No. 452,014 (4/XI/'27)—*Gesells. f. Chem. Ind. in Basel.*—The fundamental intermediate is 3-amino-naphthalene-1-8-dicarbonic acid, which may be used either as first or second component; i.e., either diazotized and coupled to a desired second or passive component, or used without diazotization as a second component, to which other diazo-compounds may be coupled. The products are then treated with any

chromium compound which will introduce chromium into the dyestuff molecule. Since there are two carboxyl groups present, the products will be more or less capable of being used as mordant dyestuffs if desired, and by choosing suitable other components, sulphonated or not, the products will be either acid dyestuffs or pigments, or can be converted from the latter state into lakes. A considerable range of color-tones is available; yellow, orange, red, violet, green (the latter mostly by after-chroming the dyeings).

Azo Dyestuffs Containing Chromium

German Patent No. 450,997 (24/X/'27)—*Gesells. f. Chem. Ind. in Basel.*—The usual method is employed, of treating suitable dyestuffs with a compound containing chromium, such as will introduce chromium into the molecule. The dyestuffs covered in this case are those obtained by coupling ortho-hydroxy diazo-compounds with amino derivatives of the naphthalene series, which by reason of other substituting groups give couplings ortho the amino-group. The products are acid dyestuffs, dyeing green to bluish-green or greenish-blue. Two examples and a table are given.

Azo Dyestuffs Containing Chromium

German Patent No. 450,819 (20/X/'27)—*Gesells. f. Chem. Ind. in Basel.*—Azo dyestuffs obtained by coupling diazo derivatives, with the diazo group ortho to a hydroxyl, to barbituric acid or its N-derivatives (alkyl, aralkyl, or aryl), are treated with compounds which will introduce chromium into the dyestuff molecule. The products are acid dyestuffs (the diazo component usually contains at least one sulphonic group) dyeing wool yellow to red or brown, the dyeings being very fast to light, fulling, or potting. The original unchromed dyestuffs give about the same tones, which on after-chroming are of about the same color, and are of course much faster. The new products attain this fastness without the need of after-chroming. Nine examples are given, with a table.

Ortho-hydroxy Azo Dyestuffs

German Patent No. 459,989 (26/IV/'28—*I. G. Farben-Ind. A.-G.*—Dyestuffs employing beta-naphthol or its sulphonic acids as a second component have been very well known for a long time. In the present procedure, 4-halogenated 2-naphthols or their substitution-products are so employed. The products thus obtained are greater in strength and bluer in tone than the unhalogenated homologues. After-chroming yields dyeings of corinth, bordeaux, blue, etc., very fast to light.

Azo Dyeings Containing Chromium

German Patent No. 455,277 (12/I/'28)—*I. G. Farben-Ind. A.-G.*—The point of the present patent lies in the introduction of less chromium than usual into the "chromable" grouping. Most chromium-containing dyestuffs have been prepared by introduction of at least one atom of chromium into each group capable of taking any up. The new products, containing altogether less than one atom of chromium per chromable group, differ from the corresponding more fully chromed dyestuffs by different color-tones, but the same fastness-properties are retained.

Three examples are given, using, e.g., a solution of chromium formate at a temperature of 125°-130° C., in an autoclave.

Azo Dyestuffs Containing Chromium

German Patent No. 446,930 (13/VI/'27)—*Gesells. f. Chem. Ind.*—Of the components required, it is specified that the second component be 3-hydroxynaphthalene-1-8-dicarbonic acid, and that the amino-compounds used for diazotization contain at least one sulpho, carboxyl, or hydroxyl group. The azo dyestuffs produced from these are then treated with chromium compounds which will introduce chromium into the molecule. The products show a tendency to work well as mordant dyestuffs, which tendency is accentuated by choosing such amines as will favor such action; for example, diazotized o-hydroxy-amino compounds. Such couplings, treated with compounds which introduce chromium or copper, give products very fast to light, etc. Five examples are given, and a table.

NEW PATENTS

(*Abstracted by Synthetic Organic Chem. Mfrs. Ass'n*)

Purification of Vat Dyes and Intermediates. (Relates to the purification of a nitrated perylene dye-forming compound which is resistant to hypohalites and which contains non-vatable material, by subjecting the impure nitroperylene compound to the action of a mild alkaline oxidizer.) Herbert J. West, of Crafton, Pa., assignor to the Seldon Co., of Pittsburgh, Pa., No. 1,845,378, February 16, 1932.

Sulphur Vat Dyestuffs. (Of the anthraquinone series, comprises heating an imide-chloride of di-2'-anthraquinonoyl-para-diaminoaryl with a sulphurizing agent. Products are identical with the vat dyestuffs obtainable according to U. S. Patent No. 1,440,833, the present invention having the advantage of obtaining the dyestuffs directly in a pure form. Dye cotton golden yellow shades of excellent fastness properties.) Otto Bayer, of Frankfort-on-the-Main, Ger., assignor to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,845,390, February 16, 1932.

Azo Dyestuffs. (Obtainable by coupling a diazotized aromatic amine with a 1-phenyl pyrazolone containing an amino group in the phenyl nucleus and converting the amino azo dyestuff thus obtained into the corresponding urea of thiourea derivative by treatment with phosgene or thiophosogene; dye cotton yellowish brown to red shades rendered fast to washing and light by a subsequent

treatment with suitable salts of heavy metals.) Matthias Latten, of Leverkusen-on-the-Rhine, Ger., assignor to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,845,426, February 16, 1932.

Production of Printing Pastes and Prints Therefrom. (Printing pastes free from alkali comprising an organic dyestuff, ordinarily requiring alkali for its fixation on fibers, and polyvinyl alcohol.) Fritz Teller, of Ludwigshafen-on-the-Rhine, Ger., assignor to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,845,452, February 16, 1932.

Vat Dyestuffs of the Acridine Series. (Comprises treating a benzanthrone substituted by several anthraquinonylamino radicles of which one is connected in its 1-position to the Bzl-position of the benzanthrone with an alkaline condensing agent; give olive to brown dyeings on cotton.) Hugo Wolff, of Mannheim, and Ernst Honold, of Frankfort-on-the-Main-Fechenheim, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,845,469, February 16, 1932.

Azo-Dyestuffs Insoluble in Water and Process of Making Same. Obtained by combining any diazo-, tetrazo-, or diazo azo compound not containing sulphonic or carboxylic groups with a dihydroxy quinoline compound; yield valuable color lakes or when produced on the fiber fast dyeings and printings, the shades comprising orange-yellow, brownish-orange and yellowish-red.) Arthur Zitscher, of Offenbach-on-the-Main, and Robert Schmitt, of Darmstadt, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,846,073, February 23, 1932.

Azo-Dyestuffs Insoluble in Water and Process of Making Same. (Comprises combining a diazotized compound not containing sulphonic or carboxylic groups with (2'4-dihydroxy-6'-quinolyl) 2.3-pheno-triazole; yield shades varying from yellowish-orange, deep reddish-yellow to brownish yellow-orange.) Arthur Zitscher, of Offenbach-on-the-Main, and Robert Schmitt, of Darmstadt, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,846,074, February 23, 1932.

Halogenated N-Benzanthronepyrazolanthrones. (Comprises a N-benzanthronepyrazolanthrone with an inorganic halogenating agent in the absence of a diluent; dye cotton fast navy blue shades.) Max Albert Kunz, of Mannheim, and Karl Koeberle and Erich Berthold, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,846,122, February 23, 1932.

Vat Dyestuffs of the Anthraquinone Series and Process of Making Same. (New vat dyestuffs yielding fast grey tints, obtained by fusing a sulphonic acid of a symmetrical dibenzanthronil with caustic potash and then treating with an alkylating agent.) Bertram Mayer, Karl Krauer, and Hugo Siebenburger, of Basel, Switzerland, assignors to the firm: Society of Chemical Industry in Basle, of Basel, Switzerland, No. 1,846,133, February 23, 1932.

Vat Dyestuff of the Pyrazolanthrone Series. (New dyestuffs containing nitrogen, obtained by subjecting 2.N-pyrazolanthronyl-benzanthrones which have a negative substituent in the Bz1-position to alkaline condensation; dye cotton reddish violet to violet shades.) Heinrich Neresheimer and Wilhelm Schneider, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,846,139, February 23, 1932.

Producing Vat Dyestuffs. (Comprises condensing a halogenated ms-benzdianthrone with an a-aminoanthraquinone in a diluting medium of high boiling point in the presence of a condensing catalyst containing copper and an acid-fixing agent. Dye cotton various shades ranging from dark violet to blue to black to copper-red, etc.) Max Albert Kunz, of Mannheim, and Karl Koberle, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,846,264, February 23, 1932.

Annual Convention of Phi Psi

Announcement has been made that the annual national convention of Phi Psi Fraternity, which is the largest textile fraternity, will be held at Blowing Rock, N. C., on Friday, Saturday and Sunday, May 13th, 14th and 15th. Headquarters will be at the Green Park Hotel.

Arthur R. Thompson, Jr., Superintendent, North Carolina Finishing Company, Yadkin, N. C., near Salisbury, is grand president of the organization, which has approximately 1,500 members in the textile industry, including active members in chapters in eight textile schools and alumni and honorary members in various branches of the textile manufacturing and allied industries throughout the country. The active chapters are: Alpha, Philadelphia Textile School, Philadelphia; Beta, New Bedford (Mass.) Textile School; Gamma, Lowell (Mass.) Textile Institute; Delta, Bradford Durfee Textile School, Fall River; Eta, North Carolina State College, Raleigh; Theta, Georgia School of Technology, Atlanta; Iota, Clemson College, S. C.; and Zeta, Texas Technological School, Lubbock, Texas.

Delegates from all of these active school chapters will attend the meeting, and a large number of alumni and honorary members from various parts of the country will also be present.

J. V. Killheffer, of E. I. du Pont De Nemours & Co., Charlotte, is general chairman of the program for the meeting. Parker H. DelPlaine, of Rohm & Haas, Charlotte, and J. W. Ivey, of Mathieson Alkali Works, Inc., Charlotte, will be in charge of transportation; and F. W. Warrington, of W. A. Kennedy & Co., Charlotte, is chairman of the entertainment committee. Aug. W. Smith, Jr., Brandon Mills, Greenville, S. C., who is grand secretary of the national organization, and William G. Blair, are in charge of registration. Housing will be handled by Grand President Thompson and Otis P. Mills.

Details of the program will be announced later. Information concerning railroad schedules, etc., may be secured from Parker H. DelPlaine, Independence Building, Charlotte, N. C.

NEW IDEAS IN WOOL SCOURING, MILLING, SHRINKING AND FINISHING

(Continued from page 216)

the following, obtained in conjunction with H. Chang, are more recent. As in earlier experiments, the pieces of cloth were allowed to stand 24 hours in acid solution and then milled with the solution with which they had come to equilibrium.

Milling Agent.	pH	Reduction in Area in 2 Hours. %
Water	8.70	21.9
Acetic acid	5.04	20.7
Acetic acid	3.76	22.2
Acetic acid	3.12	27.2
Acetic acid	2.68	33.3
Acetic acid	1.74	42.0

Comparative experiments carried out with mineral acids and acetic acid show that at the same pH acetic acid is a better milling agent than the mineral acids, but the result is of theoretical interest only, because immense concentrations of acetic acid are necessary to give the same pH as a moderate concentration of, say, hydrochloric acid. From the above results it is obvious that within the stability region (pH 4 to pH 8) the milling shrinkage is at a minimum, and practically independent of pH. The rate of shrinkage begins to increase from pH 4 onwards in the direction of increasing acidity (decreasing pH). Similar observations apply to the earlier results for sulphuric and hydrochloric acids. The swelling of wool fibers also follows the same course as milling shrinkage with media of varying acidity, as shown by the following figures for sulphuric acid:—

pH	Increase in Diameter (Diameter in Water = 100)
4.02	0.18
3.27	0.77
2.09	1.60
0.57	1.95
1.96	1.84

Similarly, the swelling of wool fibers increases with increasing alkalinity of the medium with which they are in equilibrium. This very close parallel between the rate of milling and the swelling of fibers seemed to leave no doubt that fiber-swelling is a vital factor in milling. It was, however, never indicated how swelling can affect the rate of shrinkage of fabrics. Actually, there is no direct relation between fiber-swelling and milling, as will now be proved.

Harrison (Wool Industries Research Association) claims to have shown that the rate of milling of wool fabrics under any one set of conditions is a maximum at about 46° to 49° C. No data have been published, and as the matter is one of the greatest significance, the rate of shrinkage of wool fabrics milled with soap at different temperatures has been redetermined in conjunction with H. Chang. The temperature of maximum rate of milling was found to be 43.5° C., in fair agreement with Harrison's value. The swelling of cotton in water, however, was known to be a minimum at about 46° C., and, in view of the many broad similarities between the two fibers, wool and cotton, determinations of the swelling

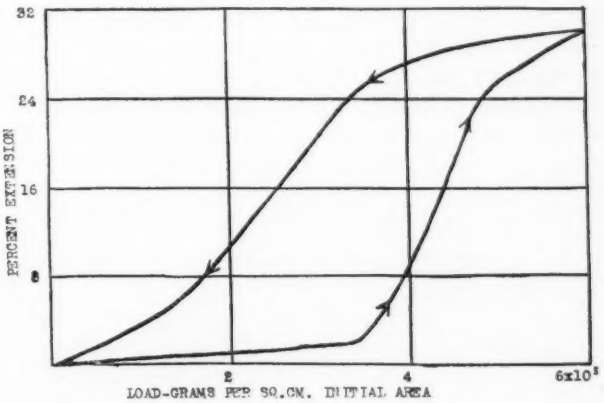

Fig. 2

of wool fibers in water at different temperatures were undertaken. The swelling was found to be a minimum at about 40°C. Thus, as far as change of temperature is concerned, the rate of milling is a maximum when the swelling is a minimum; whereas, with changing concentration of acid, the rate of milling increases as the swelling increases. This contradiction proves that swelling plays no direct part in milling, but is only indirectly related to some factor which is immediately involved. Once this stage in the argument is reached it is immediately evident what the missing factor is. It is the ease of extension of the wool fiber. Thus, the ease of extension of fibers increases with rise of temperature, and so does the rate of milling, at least up to 43.5° C. Similarly, as shown by the pH-stability curve, the ease of extension increases with increasing acidity and alkalinity, and so does the rate of milling. Also wool fibers are uniformly most difficult to stretch between pH 4 and 8, and, as shown by the data for milling in presence of acetic acid, the rate of milling is at a minimum within these same limits of pH. The parallel between extensibility and milling is thus remarkably perfect, and it is, further, immediately obvious why extensibility should play a part in milling. When pressure is applied to a fabric at any point in a given direction, certain fibers will be forced onwards in the direction of the root end. Should the tip end be mechanically entangled, the fiber can only travel and penetrate other entanglements if it is stretched. When the pressure is removed, the fiber will tend to return to its original unstretched form, but this is difficult because the scales oppose return in one direction, and the mechan-

ical entanglement opposes return at the other end of the fiber. Elastic recovery can, therefore, occur only by drawing together the two entanglements of the fiber—*i.e.*, by causing shrinkage of the cloth. In some respects this view of milling shrinkage is a combination of the views of Shorter on the milling process with those of Arnold ("Leipziger Monats.," 1929, 463, 507, 540) on felting, and there is only one fact left unaccounted for. Wool fibers in water become easier and easier to stretch as the temperature is increased up to 100° C. This being the case, the rate of milling of wool fabrics should increase continuously up to 100° C., but it reaches a maximum at 43.5° C. It must, however, be remembered that according to the present view of milling shrinkage, fibers must not only be stretched, but must also show perfect elasticity, for shrinkage to occur. If the recovery of fibers from strain is impaired beyond a certain temperature, there would be two opposing processes in operation; extensibility increases continuously with rise of temperature up to 100° C., recovery decreases at temperatures above some critical temperature below 100° C., and the rate of milling would then be a maximum at a temperature also below 100° C. Actually, at any one temperature there is a considerable lag between the processes of extension and contraction, as shown by the hysteresis loop for a wool fiber in water at 25° C. (Fig. 2). The extent of hysteresis for wool fibers in water at different temperatures has been determined; width rise of temperature the hysteresis (relative to the ease of extension) at first decreases, reaching a minimum at 30° C., and up to this temperature milling will be facilitated by the increasing ease of extension of fibers and by the decreasing hysteresis between the processes of extension and contraction. Between 30° and 40° C. the hysteresis tends to rise, and milling should, therefore, decrease slightly, but the effect would be easily compensated by the greater ease of extension with rise of temperature. Above 40° C. the hysteresis increases rapidly, and it seems reasonable that this effect should outweigh that of increasing ease of extension at about 43.5° C., giving a maximum rate of milling at that temperature. Thus, the present theory is able to explain every known fact regarding the milling process. From the preceding investigation it is now clear that for milling shrinkage to be possible it is not merely sufficient for a fiber to possess surface scales —it must also be perfectly elastic. It is noteworthy that wool and other similar animal fibers are the only ones which exhibit this second characteristic. In conjunction with W. Sever, the writer has devised methods (which have, unfortunately, been patented) for imparting a scale structure to rayon filaments with a view to making them capable of undergoing milling shrinkage. It is now clear that these attempts were misguided, because rayon filaments are, for the present at least, remarkable for imperfections of elasticity.

The Unshrinkable Finish

A few words remain to be said about the chlorination process for imparting an unshrinkable finish to wool goods. It aims at preventing milling shrinkage by making the scales inoperative, and consists simply in immersing the fabric in a solution of chlorine or hypochlorous acid. As has already been indicated, the scales are far more resistant to attack than the cortex of the fiber, and the chlorine penetrates the scales to attack the cortex. The success of chlorination does not depend on its ability to eat away the free edges of the scales—chlorinated wool fibers, when dry, appear to be no different from ordinary wool fibers. The real reason for the success of the process is that the chlorine attacks the layer of the cortex immediately underlying the scales and makes it extremely susceptible to attack by alkaline reagents (Speakman and Goodings, "J.T.I.," 1926, T607). On treatment with soap or soda after chlorination, the attacked cortex is converted into a jelly which is located between the scales and the unattacked cortex. In other words, when the liquor is sufficiently alkaline for milling shrinkage to occur, the scales are only very loosely attached to the fiber, and under the action of the milling machine they are themselves removed instead of promoting shrinkage when stretched fibers contract. The presence of scales is, however, necessary for good wearing properties, and chlorinated wool must therefore be somewhat defective in this respect. The difficulty is all the more accentuated by the enormous affinity of wool for chlorine, which causes very irregular adsorption of the reagent, and in extreme cases intense local damage to the fibers. Careful manipulation may overcome the difficulty to a very large extent, but there can be no doubt that the housewife's opinion of chlorinated wool is definitely critical.

On the previous indefinite views as to the nature of milling shrinkage there appeared to be no way of escape from the dilemma—to prevent shrinkage, either the scales must be eaten away or else temporarily detached from the cortex, both methods causing inferior wearing properties. The new view of milling shrinkage suggests another alternative. For milling shrinkage to occur, a fiber must possess two properties—it must have a surface scale structure and it must be perfectly elastic. There are thus two ways of making wool unshrinkable; either to make the scales inoperative as in existing processes, or to make the fiber imperfectly elastic. In the latter case the fiber would not be made permanently inelastic, or the fabric would lose its characteristic handle and appearance. What is required is some reagent which can be added to a scouring medium to make the fibers temporarily inelastic while laundering is carried out, the reagent being washed out when the fabric is clean and perfect elasticity restored. If such a reagent can be found, it would be a great boon to hosiery manufacturers and launderers in particular. It would confer an enormous benefit on the wool trade by removing the stigma of inferior wearing properties from hosiery goods in particular.

Corrections

The following corrections should be noted in connection with the fifth part of the "Introductory Study of Textile Microbiology" by William G. Chace appearing in the February 1st issue of this journal:

Page 101, line 11, column 1, read *irreproducible* for *irresponsible.*

Page 101, line 14, column 2, read *and a third cc. of 1-1 to a bottle* for *a third cc. of 1-10,* etc.

Page 102, line 18, column 1, insert *and,* the line then reading *medium an acid reaction and a high sugar content.*

Page 102, line 3, from the end, second column, read *1-1* for *1-10.*

Page 103 after last line insert these literature references

2—Henrici, "Molds, Yeasts, and Actinomycetes," John Wiley and Sons, New York, 1930.

3—Thom and Church, "The Aspergilli," Williams and Wilkins, Baltimore, 1930.

25—W. G. Chace, Am. Dye. Rep. 20:747 (1931).

Note—The term 1-1 is applied by bacteriologists to the original undiluted solution and is so used in these articles.

In the January 4th issue, page 15, thirteenth line from the bottom, right hand column, should read—*Alkalinity on the Deterioration of cotton, etc.,* rather than *determination.*

New Ciba Circulars

Card illustrating the following products have been sent out by the Society of Chemical Industry in Basle:

908. Rosanthrene and Diazo Colors which reserve Acetate White. Only Beta Naphtol and Yellow Developer C are used as developers as Toluyene Diamine and Phenyldiamine tint the acetate silk brown after a short time.

363. Alizarine Saphire Blue GGR, light fastness 2, may be used in dyeing yarn or piece wool, such as carpet yarn, ladies wear, curtain and upholstery material.

365. Rigan Blue 3 G Pat. and Rigan Grey G Pat. Both colors are used for dyeing of streaky artificial silk material.

897. Chlorantine Fast Blue 3GLL. It is used for the production of faster to light upholstery and dress goods made of cotton, viscose, unweighted silk and cotton viscose material.

These products are distributed by the Ciba Company.

Tonnage Production of Sodium Hydrosulphite

The Royce Chemical Company, Carlton Hill, N. J., manufacturers of Textile Chemicals, is now producing Sodium Hydrosulphite under the trade name of Vatrolite, in large tonnage on a commercial scale. They are one of the few manufacturers of this product in the United States.

This material is used for the reduction of vat colors and as a stripping agent.

Vatrolite is packed in 250 lb. containers and all shipments are subjected to careful checking, to conform with essential standards of quality.

Sales Convention

The first joint sales convention of The Calco Chemical Company, Inc. and its associated company, Heller & Merz Corporation, was held on February 12th and 13th at the Calco main office at Bound Brook, New Jersey. Approximately 50 representatives from all the branch offices attended.

The first day was devoted to meetings addressed by Mr. R. C. Jeffcott, President of The Calco Chemical Co., Inc.; Messrs. F. M. Fargo, Jr. and August Merz, Vice-Presidents; Mr. W. J. Robertson, Vice-President of Heller & Merz Corporation; Mr. J. H. McMurray, Dr. V. L. King, Mr. R. M. Taylor, Mr. J. W. Boyer, Mr. N. B. Conley, and Mr. O. A. Badenhausen.

The convention was closed the following day with a discussion of individual trade problems between the department managers and salesmen. The salesmen also were given an opportunity to inspect the plant under the guidance of the operating superintendents.

To Manufacture Finishing Machines

Riggs & Lombard, a new concern with headquarters at Suffolk St., Lowell, Mass., has been organized for manufacturing and marketing a complete line of fulling machines, dye kettles, washers, rolls, reels, etc. H. C. Riggs was formerly with the Rodney Hunt Machine Co., Orange, Mass., for nine years as head of the Textile Department, and C. J. Lombard was his assistant for three years. Associated with Messrs. Riggs and Lombard will be several others of the Rodney Hunt Co. It is announced that the new concern has ample manufacturing and financial resources and that efforts will be concentrated on the production of new and improved designs of machinery.

Lowell Textile Show

"Square Crooks" is the name of the play selected for presentation this year by the Textile Players of the Lowell Textile Institute. The production is scheduled for Friday evening, April 15th in the Memorial Auditorium in Lowell, Mass. Dancing will follow and continue until 2 A.M. Music will be furnished by MacEnnelly's orchestra.

Display at Knitting Arts Exhibition

How the properties of Monel Metal are being used by the textile industry for dyeing equipment that permits the rapid changing from one color to another will be emphasized by The International Nickel Company's display at the Knitting Arts Exhibition at the Commercial Museum, Philadelphia, from April 11th to 16th, inclusive.

The exhibit will be located in booths 76 and 77 and will be in charge of E. A. Turner assisted by C. J. Bianowicz.

Booth At Show

E. F. Houghton & Co., manufacturers of oil and leather specialties for the textile trade will have a large display this year in Booths 308, 308-AA, 309 and 309-AA at the Knitting Arts Exposition in Philadelphia. Their booth will be constructed around a mammoth revolving exhibit, 8 ft. in diameter, depicting the various branches of the knitting trade. Their display will feature several new products of the Houghton Research Staff.

Lowell Textile Alumni Meeting

Henry Lauten, chairman of the Textile Converters' Association, addressed the New York Section of the Lowell Textile Alumni at its dinner in the Happiness Restaurant, Fifth Ave. at 44th St. He is inclined to believe, he said, that the tariff is largely responsible for the difference between good times and bad, and that signing the present tariff bill was a serious mistake.

Mr. Lauten declared that a serious deficiency in the textile trade is the absence of any leader sufficiently strong to set prices at a profitable level. Nevertheless he sees encouraging signs in the growing capacity of the country to consume textiles, due to increasing birth rate and decreasing death rate, and in the shrinking capacity of the industry to produce. He declared that no substantial improvement in business can be expected until more plants have gone beyond the possibility of quick rehabilitation. He criticized elimination of commodity freight rates by the Interstate Commerce Commission and declared that New England's arguments for preferentially lower rates from the West are fallacies.

The alumni meeting was arranged particularly as an "old timers' night." In the election of officers A. J. Winkler was returned to the presidency; and H. R. Mauersberger, to the secretary-treasurership.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED

Textile Chemist and Colorist with ten years' practical experience, being available, solicits inquiries. Address Box No. 710, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Expert dyer with twenty-seven years' experience, cottons, rayons and silk mixtures. Capable of taking charge of any dyehouse. Good credentials. Age fifty-four. Address Box No. 720, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Piece dyer, rayons, silks and cottons; pads, jigs and reels. Ten years' experience, good matcher. Can give good references. Age thirty-one. Address Box No. 721, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Experienced dyestuff salesman, also demonstrator, desires connection. Would consider taking charge of a dye-house.

Thoroughly experienced dyeing yarns, raw stock, hosiery, rayons.

Acquainted in Southern territory, also familiar with mills in Massachusetts and Rhode Island. Satisfactory references.

Address Box No. 717, American Dyestuff Reporter, 440 Fourth Avenue.

SUPERINTENDENT DYER

College education, 18 years' practical experience. processing and dyeing silk, art silks, cotton and mixtures in skeins, ribbons and piece-goods on pads, jigs, reels or vats. Direct and fast colors. Highest economy on chemicals and dyestuffs. Close matches. Good references. Prefer New York or vicinity. Employed yet. Reply: Box No. 724, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

WANTED

Ribbon Dyer—experienced on half silk and rayon ribbons. Reply in detail, with references. Box No. 725, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.